What is claimed is:

Sub A1

1. A color characterization method for characterizing a color imaging system, the method comprising:

generating first color values in a color coordinate system by using output samples of the color imaging system, the first color values representing colors of the output samples of the color imaging system; and

converting the first color values into second color values in a device-independent color coordinate system using first and second reference values, the first reference values being adjusted using the first color values.

2. A color characterization method, according to claim 1, further comprising calculating the second reference values as a function of a medium.

3. A color characterization method, according to claim 2, further comprising defining the second reference values as a vector of zeros.

4. A color characterization method, according to claim 2, further comprising defining the second reference

values using a maximum value in a black channel of the color imaging system and minimum values in at least one additional channel of the color imaging system.

Sub a1

5. A color characterization method, according to claim 2, further comprising defining the second reference values using maximum values in channels of the color imaging system.

6. A color characterization method, according to claim 1, further comprising calculating the first reference values using the second reference values.

6 ~~7~~. A color characterization method, according to claim 1, further comprising generating the first color values using at least one of the following: a color measuring device, and a memory.

Sub a2

8. A color characterization method for characterizing a color imaging system, the method comprising:

generating first color values in a color coordinate system by using output samples of the color

imaging system, the first color values representing colors of the output samples;

converting the first color values into second color values in a device-independent color coordinate system using first and second reference values;

calculating the second reference values as a function of a medium;

calculating the first reference values using the second reference values; and

adjusting the first reference values using the first color values.

9. A color characterization method, according to claim 8, wherein the device-independent color coordinate system uses white reference tristimulus values to compensate for certain perceptual effects.

10. A color characterization method, according to claim 9, further comprising:

converting the first color values into the second color values using transformations; and

adjusting the first reference values using the first color values.

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~~11~~. A color characterization method, according to claim 7 ~~8~~, wherein the device-independent color coordinate system is an $L^*a^*b^*$ color coordinate system.

Sub B3

12. A color characterization method, according to claim 11, further comprising:

converting the first color values into the second color values using the equations

$$L^* = 116((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3} - 16$$

$$a^* = 500[((X - X_{bp}) / (X_n' - X_{bp}))^{1/3} - ((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3}]$$

$$b^* = 200[((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3} - ((Z - Z_{bp}) / (Z_n' - Z_{bp}))^{1/3}],$$

wherein

X, Y, and Z are tristimulus values for the first color values,

X_n', Y_n', and Z_n' are the first reference values, and

X_{bp}, Y_{bp}, and Z_{bp} are the second reference values; and

adjusting the first reference values using the tristimulus values.

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13. A color characterization method, according to claim 12, further comprising adjusting the first reference values using the equations

$$X_n' = X_b(1 - sat(X, X_{bp}, X_n)) + X_n \cdot sat(X, X_{bp}, X_n)$$

$$Y_n' = Y_b(1 - sat(Y, Y_{bp}, Y_n)) + Y_n \cdot sat(Y, Y_{bp}, Y_n)$$

$$Z_n' = Z_b(1 - sat(Z, Z_{bp}, Z_n)) + Z_n \cdot sat(Z, Z_{bp}, Z_n),$$

wherein

$$sat(X, X_{bp}, X_n) = (X - X_n) / (X_{bp} - X_n)$$

$$sat(Y, Y_{bp}, Y_n) = (Y - Y_n) / (Y_{bp} - Y_n)$$

$$sat(Z, Z_{bp}, Z_n) = (Z - Z_n) / (Z_{bp} - Z_n)$$

X_n, Y_n, and Z_n are tristimulus values for a perfect white diffuser under standard viewing conditions, and

X_b, Y_b, and Z_b are tristimulus values for an imaging base associated with the color imaging system.

14. A color characterization method, according to claim 11, further comprising:

converting the first color values into the second color values using the equations

$$L^* = 116(Y / Y_n')^{1/3} - 16$$

$$a^* = 500[(X / X_n')^{1/3} - (Y / Y_n')^{1/3}]$$

$$b^* = 200[(Y / Y_n')^{1/3} - (Z / Z_n')^{1/3}],$$

~~wherein~~

X, Y, and Z are tristimulus values for the first color values, and

X_n', Y_n', and Z_n' are the first reference values; and

adjusting the first reference values using the tristimulus values.

15. A color characterization method, according to claim 14, further comprising adjusting the first reference values using the equations

$$X_n' = X_b(1 - sat(X, X_{max}, X_n)) + X_n \cdot sat(X, X_{max}, X_n)$$

$$Y_n' = Y_b(1 - sat(Y, Y_{max}, Y_n)) + Y_n \cdot sat(Y, Y_{max}, Y_n)$$

$$Z_n' = Z_b(1 - sat(Z, Z_{max}, Z_n)) + Z_n \cdot sat(Z, Z_{max}, Z_n),$$

wherein

$$sat(X, X_{max}, X_n) = (X - X_n) / (X_{max} - X_n)$$

$$sat(Y, Y_{max}, Y_n) = (Y - Y_n) / (Y_{max} - Y_n)$$

$$sat(Z, Z_{max}, Z_n) = (Z - Z_n) / (Z_{max} - Z_n)$$

X_n, Y_n, and Z_n are tristimulus values for a perfect white diffuser under standard viewing conditions,

Sub a3

X_{max}, Y_{max}, and Z_{max} are tristimulus values for a color having a maximum saturation associated with the color imaging system, and

X_b, Y_b, and Z_b are tristimulus values for an imaging base associated with the color imaging system.

~~16~~ 15. A color characterization method, according to claim ~~8~~ 1, further comprising generating the first color values using at least one of the following: a color measuring device, and a memory.

Sub a4

17. For use in characterizing a color imaging system, a color characterization arrangement comprising:

means for generating first color values in a color coordinate system by using output samples of the color imaging system, the first color values representing colors of the output samples; and

means for converting the first color values into second color values in a device-independent color coordinate system using first and second reference values, the first reference values being adjusted using the first color values.

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18. For use in characterizing a color imaging system, a color characterization arrangement comprising:

Sub A4

a computer arrangement, configured and arranged to receive first color values in a color coordinate system, the first color values representing colors of output samples of the color imaging system; and

a first memory, responsive to the computer arrangement and configured and arranged to store second color values in a device-independent color coordinate system,

the computer arrangement being further configured and arranged to convert the first color values into the second color values using first and second reference values, the first reference values being adjusted using the first color values.

19. A color characterization arrangement, according to claim 18, wherein the computer arrangement is further configured and arranged to calculate the second reference values as a function of a medium.

Sub A5

20. A color characterization arrangement, according to claim 19, wherein the computer arrangement is

further configured and arranged to define the second reference values as a vector of zeros.

21. A color characterization arrangement, according to claim 19, wherein the computer arrangement is further configured and arranged to define the second reference values using a maximum value in a black channel of the color imaging system and minimum values in at least one additional channel of the color imaging system.

22. A color characterization arrangement, according to claim 19, wherein the computer arrangement is further configured and arranged to define the second reference values using maximum values in channels of the color imaging system.

23. A color characterization arrangement, according to claim 18, wherein the computer arrangement is further configured and arranged to calculate the first reference values using the second reference values.

24. A color characterization arrangement, according to claim 18, wherein the computer arrangement is

further configured and arranged to adjust the first reference values using the first color values.

~~25. A color characterization arrangement, according to claim 18, wherein the device-independent color coordinate system uses white reference tristimulus values to compensate for certain perceptual effects.~~

Sub A6

~~26. A color characterization arrangement, according to claim 18, wherein the computer arrangement is further configured and arranged to:~~

~~convert the first color values into the second color values using transformations; and~~

~~adjust the first reference values using the first color values.~~

23 ~~27~~. A color characterization arrangement, according to claim 17 ~~18~~, wherein the device-independent color coordinate system is an $L^*a^*b^*$ color coordinate system.

Sub A7

~~28. A color characterization arrangement, according to claim 27, wherein the computer arrangement is further configured and arranged to:~~

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convert the first color values into the second color values using the equations

$$L^* = 116((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3} - 16$$

$$a^* = 500[((X - X_{bp}) / (X_n' - X_{bp}))^{1/3} - ((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3}]$$

$$b^* = 200[((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3} - ((Z - Z_{bp}) / (Z_n' - Z_{bp}))^{1/3}],$$

wherein

X, Y, and Z are tristimulus values for the first color values,

X_n', Y_n', and Z_n' are the first reference values, and

X_{bp}, Y_{bp}, and Z_{bp} are the second reference values; and

adjust the first reference values using the tristimulus values.

29. A color characterization arrangement, according to claim 28, wherein the computer arrangement is further configured and arranged to adjust the first reference values using the equations

$$X_n' = X_b(1 - \mathrm{sat}(X, X_{bp}, X_n)) + X_n \cdot \mathrm{sat}(X, X_{bp}, X_n)$$

$$Y_n' = Y_b(1 - sat(Y,Y_{bp},Y_n)) + Y_n \cdot sat(Y,Y_{bp},Y_n)$$

$$Z_n' = Z_b(1 - sat(Z,Z_{bp},Z_n)) + Z_n \cdot sat(Z,Z_{bp},Z_n),$$

wherein

$$sat(X,X_{bp},X_n) = (X - X_n) / (X_{bp} - X_n)$$

$$sat(Y,Y_{bp},Y_n) = (Y - Y_n) / (Y_{bp} - Y_n)$$

$$sat(Z,Z_{bp},Z_n) = (Z - Z_n) / (Z_{bp} - Z_n)$$

Sub a17

X_n, Y_n, and Z_n are tristimulus values for a perfect white diffuser under standard viewing conditions, and

X_b, Y_b, and Z_b are tristimulus values for an imaging base associated with the color imaging system.

30. A color characterization arrangement, according to claim 27, wherein the computer arrangement is further configured and arranged to:

convert the first color values into the second color values using the equations

$$L^* = 116(Y / Y_n')^{1/3} - 16$$

$$a^* = 500[(X / X_n')^{1/3} - (Y / Y_n')^{1/3}]$$

$$b^* = 200[(Y / Y_n')^{1/3} - (Z / Z_n')^{1/3}],$$

wherein

X, Y, and Z are tristimulus values for the first color values, and

X_n', Y_n', and Z_n' are the first reference values; and

adjust the first reference values using the tristimulus values.

Sub A7

31. A color characterization arrangement, according to claim 30, wherein the computer arrangement is further configured and arranged to adjust the first reference values using the equations

$$X_n' = X_b(1 - sat(X, X_{max}, X_n)) + X_n \cdot sat(X, X_{max}, X_n)$$

$$Y_n' = Y_b(1 - sat(Y, Y_{max}, Y_n)) + Y_n \cdot sat(Y, Y_{max}, Y_n)$$

$$Z_n' = Z_b(1 - sat(Z, Z_{max}, Z_n)) + Z_n \cdot sat(Z, Z_{max}, Z_n),$$

wherein

$$sat(X, X_{max}, X_n) = (X - X_n) / (X_{max} - X_n)$$

$$sat(Y, Y_{max}, Y_n) = (Y - Y_n) / (Y_{max} - Y_n)$$

$$sat(Z, Z_{max}, Z_n) = (Z - Z_n) / (Z_{max} - Z_n)$$

X_n, Y_n, and Z_n are tristimulus values for a perfect white diffuser under standard viewing conditions,

X_{max}, Y_{max}, and Z_{max} are tristimulus values for a color having a maximum saturation associated with the color imaging system, and

Sub A7

X_b, Y_b, and Z_b are tristimulus values for an imaging base associated with the color imaging system.

28 ~~32~~. A color characterization arrangement, according to claim 17 ~~18~~, further comprising a second memory, configured and arranged to provide the first color values to the computer arrangement.

29 ~~33~~. A color characterization arrangement, according to claim 17 ~~18~~, further comprising a color measuring instrument, configured and arranged to:

obtain the first color values from a sample; and

provide the first color values to the computer arrangement.

Sub A8

34. For use in characterizing a color imaging system, a data storage medium storing a computer-executable program configured and arranged to, when executed,

obtain first color values in a color coordinate system by using output samples of the color imaging system, the first color values representing colors of the output samples, and

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convert the first color values into second color values in a device-independent color coordinate system using first and second reference values, the first reference values being adjusted using the first color values.

35. A data storage medium, according to claim 34, wherein the computer-executable program is further configured and arranged to, when executed, calculate the second reference values as a function of a medium.

36. A data storage medium, according to claim 35, wherein the computer-executable program is configured and arranged to, when executed, define the second reference values as a vector of zeros.

37. A data storage medium, according to claim 35, wherein the computer-executable program is configured and arranged to, when executed, define the second reference values using a maximum value in a black channel of the color imaging system and minimum values in at least one additional channel of the color imaging system.

38. A data storage medium, according to claim 35, wherein the computer-executable program is configured and arranged to, when executed, define the second reference values using maximum values in channels of the color imaging system.

39. A data storage medium, according to claim 34, wherein the computer-executable program is further configured and arranged to, when executed, calculate the first reference values using the second reference values.

40. A data storage medium, according to claim 34, wherein the computer-executable program is further configured and arranged to, when executed, adjust the first reference values using the first color values.

41. A data storage medium, according to claim 34, wherein the device-independent color coordinate system uses white reference tristimulus values to compensate for certain perceptual effects.

Sub a9

42. A data storage medium, according to claim 41, wherein the computer-executable program is further configured and arranged to, when executed,

convert the first color values into the second color values using transformations; and

adjust the first reference values using the first color values.

~~43~~ 37. A data storage medium, according to claim ~~34~~ 30, wherein the device-independent color coordinate system is an $L^*a^*b^*$ color coordinate system.

Sub a10

44. A data storage medium, according to claim 43, wherein the computer-executable program is further configured and arranged to, when executed,

convert the first color values into the second color values using the equations

$$L^* = 116((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3} - 16$$

$$a^* = 500[((X - X_{bp}) / (X_n' - X_{bp}))^{1/3} - ((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3}]$$

$$b^* = 200[((Y - Y_{bp}) / (Y_n' - Y_{bp}))^{1/3} - ((Z - Z_{bp}) / (Z_n' - Z_{bp}))^{1/3}],$$

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~~wherein~~

X, Y, and Z are tristimulus values for the first color values,

X_n', Y_n', and Z_n' are the first reference values, and

X_{bp}, Y_{bp}, and Z_{bp} are the second reference values, and

Sub D10

adjust the first reference values using the tristimulus values.

45. A data storage medium, according to claim 44, wherein the computer-executable program is further configured and arranged to, when executed, adjust the first reference values using the equations

$$X_n' = X_b(1 - \mathrm{sat}(X, X_{bp}, X_n)) + X_n \cdot \mathrm{sat}(X, X_{bp}, X_n)$$

$$Y_n' = Y_b(1 - \mathrm{sat}(Y, Y_{bp}, Y_n)) + Y_n \cdot \mathrm{sat}(Y, Y_{bp}, Y_n)$$

$$Z_n' = Z_b(1 - \mathrm{sat}(Z, Z_{bp}, Z_n)) + Z_n \cdot \mathrm{sat}(Z, Z_{bp}, Z_n),$$

wherein

$$\mathrm{sat}(X, X_{bp}, X_n) = (X - X_n) / (X_{bp} - X_n)$$

$$\mathrm{sat}(Y, Y_{bp}, Y_n) = (Y - Y_n) / (Y_{bp} - Y_n)$$

$$\mathrm{sat}(Z, Z_{bp}, Z_n) = (Z - Z_n) / (Z_{bp} - Z_n)$$

X_n, Y_n, and Z_n are tristimulus values for a perfect white diffuser under standard viewing conditions, and

X_b, Y_b, and Z_b are tristimulus values for an imaging base associated with the color imaging system.

Sub A10

46. A data storage medium, according to claim 43, wherein the computer-executable program is further configured and arranged to, when executed,

convert the first color values into the second color values using the equations

$$L^* = 116(Y / Y_n')^{1/3} - 16$$

$$a^* = 500[(X / X_n')^{1/3} - (Y / Y_n')^{1/3}]$$

$$b^* = 200[(Y / Y_n')^{1/3} - (Z / Z_n')^{1/3}],$$

wherein

X, Y, and Z are tristimulus values for the first color values, and

X_n', Y_n', and Z_n' are the first reference values, and

adjust the first reference values using the tristimulus values.

Sub a10

47. A data storage medium, according to claim 46, wherein the computer-executable program is further configured and arranged to, when executed, adjust the first reference values using the equations

$$X_n' = X_b(1 - sat(X, X_{max}, X_n)) + X_n \cdot sat(X, X_{max}, X_n)$$

$$Y_n' = Y_b(1 - sat(Y, Y_{max}, Y_n)) + Y_n \cdot sat(Y, Y_{max}, Y_n)$$

$$Z_n' = Z_b(1 - sat(Z, Z_{max}, Z_n)) + Z_n \cdot sat(Z, Z_{max}, Z_n),$$

wherein

$$sat(X, X_{max}, X_n) = (X - X_n) / (X_{max} - X_n)$$

$$sat(Y, Y_{max}, Y_n) = (Y - Y_n) / (Y_{max} - Y_n)$$

$$sat(Z, Z_{max}, Z_n) = (Z - Z_n) / (Z_{max} - Z_n)$$

X_n, Y_n, and Z_n are tristimulus values for a perfect white diffuser under standard viewing conditions,

X_{max}, Y_{max}, and Z_{max} are tristimulus values for a color having a maximum saturation associated with the color imaging system, and

X_b, Y_b, and Z_b are tristimulus values for an imaging base associated with the color imaging system.

42 ~~48~~. A data storage medium, according to claim 30 ~~34~~, wherein the computer-executable program is further

configured and arranged to, when executed, store the second color values in a memory.

49. A color transformation method for performing a color transformation between first and second color imaging systems, the color transformation method comprising:

Sub a11

generating first and second color values by using output samples of the first and second color imaging systems, the first and second color values respectively representing colors of the output samples of the first and second color imaging systems;

converting the first and second color values respectively into third and fourth color values using a device-independent color coordinate system;

calculating first reference values from a medium and second reference values from the first reference values;

adjusting the second reference values using the first and second color values; and

generating color transformation values using the third and fourth color values.

50. A color characterization method, according to claim 49, wherein the device-independent color coordinate

system uses white reference tristimulus values to compensate for certain perceptual effects.

51. A color characterization method, according to claim 50, further comprising:

Sub a11

converting the first color values into the second color values using transformations; and

adjusting the first reference values using the first color values.

~~52~~ 46. A color transformation method, according to claim ~~49~~ 43, wherein the color coordinate system is an $L^*a^*b^*$ color coordinate system.

~~5~~3. A color transformation method, according to claim 52, further comprising:

Sub a12

converting the first color values into the third color values using the equations

$$L^* = 116((Y_1 - Y_{bp1}) / (Y_{n1}' - Y_{bp1}))^{1/3} - 16$$

$$a^* = 500[((X_1 - X_{bp1}) / (X_{n1}' - X_{bp1}))^{1/3} - ((Y_1 - Y_{bp1}) / (Y_{n1}' - Y_{bp1}))^{1/3}]$$

$$b^* = 200[((Y_1 - Y_{bp1}) / (Y_{n1}' - Y_{bp1}))^{1/3} - ((Z_1 - Z_{bp1}) / (Z_{n1}' - Z_{bp1}))^{1/3}],$$

Sub A12

wherein

X_1, Y_1, and Z_1 are tristimulus values for the first color values,

X_{bp1}, Y_{bp1}, and Z_{bp1} are black tristimulus values for the first color imaging system, and

X_{n1}', Y_{n1}', and Z_{n1}' are white reference tristimulus values for the first color imaging system;

converting the second color values into the fourth color values using the equations

$$L^* = 116((Y_2 - Y_{bp2}) / (Y_{n2}' - Y_{bp2}))^{1/3} - 16$$

$$a^* = 500[((X_2 - X_{bp2}) / (X_{n2}' - X_{bp2}))^{1/3} - ((Y_2 - Y_{bp2}) / (Y_{n2}' - Y_{bp2}))^{1/3}]$$

$$b^* = 200[((Y_2 - Y_{bp2}) / (Y_{n2}' - Y_{bp2}))^{1/3} - ((Z_2 - Z_{bp2}) / (Z_{n2}' - Z_{bp2}))^{1/3}],$$

wherein

X_2, Y_2, and Z_2 are tristimulus values for the second color values,

X_{bp2}, Y_{bp2}, and Z_{bp2} are black tristimulus values for the second color imaging system, and

X_{n2}', Y_{n2}', and Z_{n2}' are white tristimulus values for the second color imaging system; and

~~adjusting the second reference values using the black tristimulus values for the first and second color imaging systems.~~

~~54~~ 48. A color transformation method, according to claim ~~53~~ 47, further comprising:

adjusting the white reference tristimulus values for the first color imaging system using the equations

$$X_{n1}' = X_{b1}(1 - sat(X_1, X_{bp1}, X_{n1})) + X_{n1} \cdot sat(X_1, X_{bp1}, X_{n1})$$

$$Y_{n1}' = Y_{b1}(1 - sat(Y_1, Y_{bp1}, Y_{n1})) + Y_{n1} \cdot sat(Y_1, Y_{bp1}, Y_{n1})$$

$$Z_{n1}' = Z_{b1}(1 - sat(Z_1, Z_{bp1}, Z_{n1})) + Z_{n1} \cdot sat(Z_1, Z_{bp1}, Z_{n1}),$$

wherein

$$sat(X_1, X_{bp}, X_n) = (X_1 - X_{n1}) / (X_{bp1} - X_{n1})$$

$$sat(Y_1, Y_{bp}, Y_n) = (Y_1 - Y_{n1}) / (Y_{bp1} - Y_{n1})$$

$$sat(Z_1, Z_{bp1}, Z_{n1}) = (Z_1 - Z_{n1}) / (Z_{bp1} - Z_{n1})$$

X_{n1}, Y_{n1}, and Z_{n1} are tristimulus values for a perfect white diffuser associated with the first color imaging system under standard viewing conditions, and

X_{b1}, Y_{b1}, and Z_{b1} are tristimulus values for an imaging base associated with the first color imaging system; and

adjusting the white reference tristimulus values for the second color imaging system using the equations

$$X_{n2}' = X_{b2}(1 - sat(X_2, X_{bp2}, X_{n2})) + X_{n2} \cdot sat(X_2, X_{bp2}, X_{n2})$$

$$Y_{n2}' = Y_{b2}(1 - sat(Y_2, Y_{bp2}, Y_{n2})) + Y_{n2} \cdot sat(Y_2, Y_{bp2}, Y_{n2})$$

$$Z_{n2}' = Z_{b2}(1 - sat(Z_2, Z_{bp2}, Z_{n2})) + Z_{n2} \cdot sat(Z_2, Z_{bp2}, Z_{n2}),$$

wherein

$$sat(X_2, X_{bp}, X_n) = (X_2 - X_{n2}) / (X_{bp2} - X_{n2})$$

$$sat(Y_2, Y_{bp}, Y_n) = (Y_2 - Y_{n2}) / (Y_{bp2} - Y_{n2})$$

$$sat(Z_2, Z_{bp2}, Z_{n2}) = (Z_2 - Z_{n2}) / (Z_{bp2} - Z_{n2})$$

X_{n2}, Y_{n2}, and Z_{n2} are tristimulus values for a perfect white diffuser associated with the second color imaging system under standard viewing conditions, and

X_{b2}, Y_{b2}, and Z_{b2} are tristimulus values for an imaging base associated with the second color imaging system.

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Sub a13

55. A color characterization method, according to claim 52, further comprising:

converting the first color values into the third color values using the equations

$$L^* = 116(Y_1 / Y_{n1}')^{1/3} - 16$$

$$a^* = 500[(X_1 / X_{n1}')^{1/3} - (Y_1 / Y_{n1}')^{1/3}]$$

$$b^* = 200[(Y_1 / Y_{n1}')^{1/3} - (Z_1 / Z_{n1}')^{1/3}],$$

wherein

X_1, Y_1, and Z_1 are tristimulus values for the first color values, and

X_{n1}', Y_{n1}', and Z_{n1}' are white reference tristimulus values for the first color imaging system;

converting the second color values into the fourth color values using the equations

$$L^* = 116(Y_2 / Y_{n2}')^{1/3} - 16$$

$$a^* = 500[(X_2 / X_{n2}')^{1/3} - (Y_2 / Y_{n2}')^{1/3}]$$

$$b^* = 200[(Y_2 / Y_{n2}')^{1/3} - (Z_2 / Z_{n2}')^{1/3}],$$

wherein

X_2, Y_2, and Z_2 are tristimulus values for the second color values, and

X_{n2}', Y_{n2}', and Z_{n2}' are white reference tristimulus values for the second color imaging system; and

Sub a13

adjusting the first reference values using the black tristimulus values for the first and second color imaging systems.

50 ~~56~~. A color transformation method, according to claim 49 ~~55~~, further comprising:

adjusting the white reference tristimulus values for the first color imaging system using the equations

$$X_{n1}' = X_{b1}(1 - \mathrm{sat}(X_1, X_{max1}, X_{n1})) + X_{n1} \cdot \mathrm{sat}(X_1, X_{max1}, X_{n1})$$

$$Y_{n1}' = Y_{b1}(1 - \mathrm{sat}(Y_1, Y_{max1}, Y_{n1})) + Y_{n1} \cdot \mathrm{sat}(Y_1, Y_{max1}, Y_{n1})$$

$$Z_{n1}' = Z_{b1}(1 - \mathrm{sat}(Z_1, Z_{max1}, Z_{n1})) + Z_{n1} \cdot \mathrm{sat}(Z_1, Z_{max1}, Z_{n1}),$$

wherein

$$\mathrm{sat}(X_1, X_{max1}, X_{n1}) = (X_1 - X_{n1}) / (X_{max1} - X_{n1})$$

$$\mathrm{sat}(Y_1, Y_{max1}, Y_{n1}) = (Y_1 - Y_{n1}) / (Y_{max1} - Y_{n1})$$

$$\mathrm{sat}(Z_1, Z_{max1}, Z_{n1}) = (Z_1 - Z_{n1}) / (Z_{max1} - Z_{n1})$$

X_{n1}, Y_{n1}, and Z_{n1} are tristimulus values for a perfect white diffuser associated with the first color imaging system under standard viewing conditions,

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X_{max1}, Y_{max1}, and Z_{max1} are tristimulus values for a color having a maximum saturation associated with the first color imaging system, and

X_{b1}, Y_{b1}, and Z_{b1} are tristimulus values for an imaging base associated with the first color imaging system; and

adjusting the white reference tristimulus values for the second color imaging system using the equations

$$X_{n2}' = X_{b2}(1 - \mathrm{sat}(X_2, X_{max2}, X_{n2})) + X_{n2} \cdot \mathrm{sat}(X_2, X_{max2}, X_{n2})$$

$$Y_{n2}' = Y_{b2}(1 - \mathrm{sat}(Y_2, Y_{max2}, Y_{n2})) + Y_{n2} \cdot \mathrm{sat}(Y_2, Y_{max2}, Y_{n2})$$

$$Z_{n2}' = Z_{b2}(1 - \mathrm{sat}(Z_2, Z_{max2}, Z_{n2})) + Z_{n2} \cdot \mathrm{sat}(Z_2, Z_{max2}, Z_{n2}),$$

wherein

$$\mathrm{sat}(X_2, X_{max2}, X_{n2}) = (X_2 - X_{n2}) / (X_{max2} - X_{n2})$$

$$\mathrm{sat}(Y_2, Y_{max2}, Y_{n2}) = (Y_2 - Y_{n2}) / (Y_{max2} - Y_{n2})$$

$$\mathrm{sat}(Z_2, Z_{max2}, Z_{n2}) = (Z_2 - Z_{n2}) / (Z_{max2} - Z_{n2})$$

X_{n2}, Y_{n2}, and Z_{n2} are tristimulus values for a perfect white diffuser associated with the second color imaging system under standard viewing conditions,

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X_{max2}, Y_{max2}, and Z_{max2} are tristimulus values for a color having a maximum saturation associated with the second color imaging system, and

X_{b2}, Y_{b2}, and Z_{b2} are tristimulus values for an imaging base associated with the second color imaging system.

57. For use in performing a color transformation between first and second color imaging systems, a color transformation arrangement comprising:

means for generating first color values by using output samples of the first color imaging system, the first color values representing colors of the output samples of the first color imaging system;

means for generating second color values by using output samples of the second color imaging system, the second color values representing colors of the output samples of the second color imaging system;

means for converting the first color values into third color values using a color coordinate system;

means for converting the second color values into fourth color values using the color coordinate system;

Sub a14

means for calculating first reference values from a medium and second reference values from the first reference values;

means for adjusting the second reference values using the first and second color values; and

means for generating color transformation values using the third and fourth color values.

Add a15